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In This Issue

Regional Shifts in Wheat Production . . . . . *page 3*

Some Economics of Water Use in Broad Sectors of the Economy . . *page 8*

Current Charts and Statistics . . . *page 16*

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Regional Shifts in Wheat Production

INTERREGIONAL SHIFTS in wheat production have aroused considerable discussion recently. It is frequently contended that incentives provided by the price support program, coupled with the 15-acre exemption from marketing quota requirements, have caused production to increase in areas where wheat formerly was not an important crop.

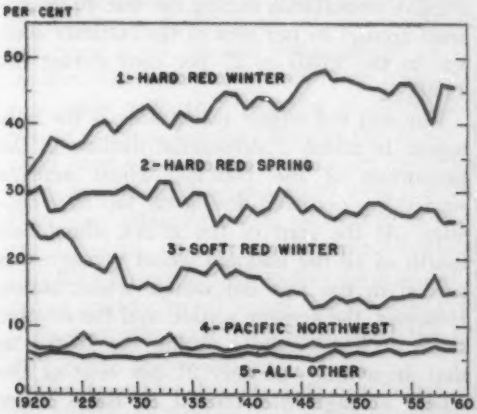
In view of the magnitude of the existing problem and adjustments that likely will be needed if the wheat situation is to improve substantially, it is desirable to analyze the importance of these interregional shifts in wheat production. Such information, along with other factors affecting wheat production and surplus accumulation, will provide useful information for better understanding of the wheat problem.

Major Wheat Regions

Wheat is grown in every state of the Union. Several market classes are grown—each adapted to different regions of the country and for certain specific uses. There are four major wheat-producing regions based on the class of wheat which predominates in each area. They are the hard red winter, hard red spring, soft red winter, and Pacific Northwest regions.

During the last four decades, there has been no discernible trend in the acreage of wheat seeded in the United States, which averaged about 65 million acres in the 1920's; 70 million acres in the 1930's; 68 million acres in the 1940's; and 65 million acres in the 1950's. At times, the acreage seeded has increased rapidly and at other times has declined sharply. These adjustments have occurred in response to changing demand and weather conditions or as a result of Government programs. Changes in regional acreages seeded have followed national trends, although the rates of change have varied among

Proportion of Seeded Acreage of Wheat In the Major Producing Regions of the U. S.



1. Hard red winter wheat states: Colorado, Kansas, Nebraska, Oklahoma, and Texas.
2. Hard red spring wheat states: Minnesota, Montana, North Dakota, and South Dakota.
3. Soft red winter wheat states: Georgia, Illinois, Indiana, Kentucky, Maryland, Missouri, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia.
4. Pacific Northwest: Idaho, Oregon, and Washington.
5. All other wheat-producing states.

SOURCE: U. S. Department of Agriculture.

regions. This has resulted in shifts in the proportions of the wheat acreage grown in the different regions.

The combined acreage in the hard red winter and hard red spring wheat regions has accounted for over 70 per cent of the total U. S. acreage seeded to wheat in each of the last three decades. These two regions which consist of the Northern, Central, and Southern Plains states frequently are referred to as the "Wheat Belt." Large land areas—well suited to large-scale wheat operations—technological innovation, and the war demand for wheat during the 1940's were conducive to a high level of wheat production in these states.

Since 1920, the relative share of the Nation's acreage seeded to wheat in the hard red winter wheat region has increased from 37 per cent in the 1920's, to 42 per cent in the 1930's, and 45 per cent in the 1940's and 1950's. The acreage seeded in the hard red spring wheat region has declined slightly in relative importance during the last 40 years—from around 29 per cent of the Nation's acreage in the 1920's to 27 per cent during the 1950's.

The soft red winter wheat area is the only region in which a substantial decline in the proportion of the Nation's wheat acreage seeded has occurred during the last four decades. At the start of the 1920's, about one fourth of all the national wheat acreage was seeded in the soft red winter wheat states. However, the acreage seeded and the relative share declined rapidly during the 1920's, so that an average of only 21 per cent of the wheat acreage was seeded in these states during that decade. The relative share of the acreage continued to decline in the soft winter wheat states through the 1940's, but has increased slightly during the 1950's. About 14 per cent of the Nation's wheat acreage has been seeded in this area during the last two decades. Typically, farms in this region grow wheat on small acreages, while the primary farm enterprises are other grain, livestock, or cash crops such as cotton or tobacco. On a majority of these farms, the acreage allotments are less than 15 acres so that this acreage can be grown and sold without violating the marketing quota provisions of the wheat program.

Around 7 per cent of the national wheat acreage during the last 40 years has been seeded in the Pacific Northwest. Although the proportion of the wheat acreage seeded in these three states has increased, the area accounted for less than 8 per cent of the average U. S. acreage during the last decade. White winter wheat is the principal type grown in this region which is dominated by large, specialized farms.

Only a small share of the Nation's wheat is grown in states outside the four previously described regions. In all other wheat-producing states, the proportion of acres seeded has remained around 5-6 per cent of the national total for the last 40 years.

Effects of Recent Acreage Controls

A frequent criticism of the wheat program has been that exemption of small producers from controls (marketing quota provisions) has spread the production of wheat and that this increased production outside the Wheat Belt is a primary cause of the surplus problem. The discussion of historical trends in the preceding section demonstrated that during the last decade there has been no significant shift in production patterns as measured by acreage seeded. A comparison of the relative acreages in recent noncontrol years with those in control years is necessary to determine if restriction programs had an effect on regional wheat production patterns.

Although attempts had been made to control wheat acreage under the Agricultural Adjustment Act of 1933 and the Soil Conservation and Domestic Allotment Act of 1936, this type of control did not prove effective in re-

stricting acreage until allotments were coupled with marketing quotas under the Agricultural Adjustment Act of 1938. However, shortly after passage of this legislation, the high wartime demand resulted in removal of production controls and raising of the support price to 90 per cent of parity. After the war, demand continued at a high level, but by 1949, world wheat productive capacity had recovered and demand for wheat to be exported declined, so acreage allotments were imposed for the 1950 crop. The Korean crisis again caused allotments to be dropped. Easing of the crisis caused both acreage allotments and marketing quotas to be imposed on the crop to be harvested in 1954, when the national allotment was set at 62 million acres. The allotment was reduced to the minimum allowable of 55 million acres in 1955 and, since then, has been at that acreage.

The acreage allotments imposed for the 1954 crop were based on the acreage seeded to wheat in the previous 10 years. Thus, much of the relative increase in wheat plantings in the Plains states, which resulted from the high war and postwar demand, was perpetuated in the allotment structure. In the years since 1954, adjustments have been made in the allotments of individual states, but the relative shares of the major wheat-producing regions have not been affected significantly by these adjustments. For 1954, the nine Great Plains states, which include both the hard red winter and hard red spring wheat regions, had 73.4 per cent of the allotted acres, while this area's share for 1960 is still over 73 per cent of the national acreage allotment.

Since the imposition of acreage allotments and marketing quotas for the 1954 crop, an additional 400,000 farms—principally in the Midwest and South—have started producing wheat. Although this tends to indicate increased production in these areas, the acreage seeded to wheat actually has declined. The control programs were a strong inducement for acreage reduction on farms with more than a 15-acre wheat base. On the other hand, because of the marketing quotas, farmers without a wheat base would hesitate to plant more than 15 acres. Thus, there was a tendency for part of the acreage reduction achieved on the larger farms to be offset by the increased acreage seeded on farms that did not have a wheat base. Because of these conditions, the reduction in acreage in recent years has not been so great in the soft red winter wheat region as for the Nation or other regions. For the Nation, the acreage seeded for the 1959 wheat crop was about 26 per cent less than for the 1953 crop. This compares with a 31 per cent reduction in the hard red spring wheat region; 30 per cent in the Pacific Northwest; 26 per cent in the hard red winter wheat region; 21 per cent in the soft red winter wheat region; and an average of 25 per cent in all other wheat-producing states.

The acreage seeded to wheat has exceeded the allotted acreage in all regions, except in the years when the Soil Bank offered an attractive alternative. Some farmers plant excess acres with the intention of destroying poorer patches, but they harvest the excess if yield expectations are exceptionally good for all of the seeded acreage as they were in 1958. However, producers with allotments exceeding 15 acres, who overplant their allotment and do not destroy their excess acreage, must pay a penalty on all wheat sales in excess of their marketing quotas or must store the excess wheat under seal.

The expansion of the area designated by the USDA as "commercial wheat producing" also lends credence to the belief that wheat production has increased outside the Wheat Belt. In 1954, there were 2,694 commercial wheat counties compared to 2,843 in 1959. The number of commercial wheat states also increased. There are nine states (excluding Alaska) currently classified as noncommer-

cial, compared with 12 in 1956. A noncommercial wheat state is one where the wheat allotment is less than 25,000 acres. All noncommercial wheat states are located in areas outside the major wheat-producing regions. Neither the proportion of the Nation's seeded acreage nor acreage allotment in these states has increased significantly since adoption of controls for the 1954 and subsequent crop years. Although wheat production has increased in some of these states, it has declined in others.

In the 3 crop years before controls were resumed, 1951-53, the nine Great Plains states planted 73 per cent of the Nation's wheat acreage. In the 5 years since then, during which control programs have been operative, this area has seeded an average of over 71 per cent of the wheat acreage. During much of this latter period, the Plains area was affected by a serious drought. Crop prospects were not favorable during the 1956 and 1957 crop years, and wheat growers were offered an attractive alternative in the acreage reserve provision of the Soil Bank. Returns from placing part of the wheat allotment in the acreage reserve during those 2 years offered prospects of higher returns than did planting wheat. As a consequence, a total of over 16 million acres of Great Plains wheat land was put into the acreage reserve. In 1957, these nine states accounted for 10.8 million of the 12.7 million acres of wheat land put into the acreage reserve portion of the Soil Bank. If the land taken out of wheat production and placed in the acreage reserve is added to seeded acreage, the proportion of the Nation's wheat land in the Great Plains states since 1954 is increased to over 72 per cent, only about 1 per cent less than during the previous 3 years, and about the same proportion as during the last 20 years.

A comparison of wheat production in the Wheat Belt with that in other areas of the Nation implies that production has moved out of the Wheat Belt since 1953—the period during which both price support and marketing quota programs have been operative. This implication, however, also is deceptive. Although the Great Plains states have produced only about 57 per cent of the U. S. wheat crop in the 1950's compared to about 66 per cent in the 1940's, the reduction was caused more by unfavorable weather conditions in these states than by acreage shifts. As previously indicated, the proportion of the Nation's wheat planted in the Wheat Belt was about the same in both decades, despite the relative shift in production.

Wheat production in the Plains states was severely affected by drought conditions from 1953 through 1956, whereas other wheat-producing regions, located in more humid areas, were less affected by unfavorable weather conditions. In addition to low yields, as previously indicated, poor prospects for the 1956 and 1957 crops in the Plains states at seeding time caused large acreages to be put into the Soil Bank, and this further reduced production. With favorable prospects for the 1958 crop at seeding time, land was taken out of the Soil Bank and again planted to wheat. The 1958 wheat crop was produced under very favorable weather conditions throughout the United States, and the proportion of wheat produced in the Plains states was nearly 68 per cent of the national total. Preliminary estimates for 1959, with weather conditions more normal, indicate that 62 per cent of the U. S. wheat will be produced in the 9-state Wheat Belt. Thus, production in the Plains states during the past 2 years has approached the same relative importance that prevailed during the 1940's. Analysis of both acreage seeded and production indicate that the shift in the relative importance of wheat grown within and outside the Wheat Belt has not been large enough to be a significant factor in the accumulation of the surplus wheat stocks during recent years.

The Wheat Surplus

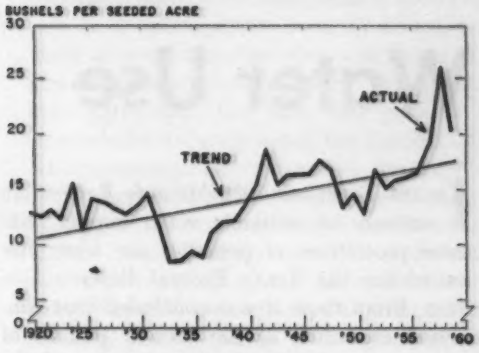
If, as the preceding analysis indicates, the principal cause of the wheat surplus has not been increased production in areas outside the Wheat Belt, the surplus must be assigned to other causes. Three interrelated factors have been important in contributing to development of the existing surplus.

The first of these has been a lower U. S. per capita consumption of food products made from wheat. This has been offset largely by increased population and has resulted in a relatively stable rather than increasing domestic demand for wheat as a food product.

The second contributing factor has been a price structure that has prevented wheat from being used for alternative purposes (e.g., as a feed grain or for industrial processing) and that has precluded sales of wheat in world markets except on a subsidized basis. This factor, together with the decline in per capita consumption of wheat-derived foods, has resulted in limiting the quantity of wheat used for all purposes.

The third factor has been on the supply side. It is the improvements in technology and management which have enabled a high level of wheat production to be maintained. These improvements, along with the aid of favorable weather in 1958, resulted in a record-breaking output despite a reduction in wheat acreage of about a fourth from pre-control levels. This high level of production has thwarted endeavors to hold wheat supplies in line with demand at prevailing prices.

Wheat Yield Per Seeded Acre, U. S.



SOURCE: U. S. Department of Agriculture.

Wheat yields, especially within the Wheat Belt, are highly variable. However, despite periods of severe droughts, yields for the Nation have shown a definite upward trend during the last four decades. This trend has been at an average annual rate of about a fifth of a bushel per seeded acre of wheat. The increase in yields has resulted partly from improved techniques such as better varieties, better farming practices, use of more fallowing, and increased use of fertilizers and insecticides. In addition, wheat programs have encouraged the poorest land of a farm or area to be removed from production. As the allotments have been reduced, farmers have tended to substitute other resources for land in their efforts to maintain production and keep income at more favorable levels. In these efforts, they have been successful.

Some Economics of Water Use in Broad Sectors of the Economy

In the February 1959 *Monthly Review*, an estimate of available water supply and some projections of potential use were presented for the Tenth Federal Reserve District. From these it was concluded that continued expansion of the present pattern of water use might, for the District as a whole, result in the consumptive use of the entire continuously available water supply by 1975. Since water and economic activity are both unevenly distributed, this would mean that specific localities might well experience stringency in the supply of this resource long before 1975 while others would perhaps still enjoy an appreciable surplus. Indeed, in some areas of the District, competition for available water supplies by alternative uses is a present fact and, in numerous others, it is clearly on the horizon. An investigation aimed at determining the relative efficacy of different possible uses of water for achieving regional goals would seem to be a necessary prerequisite to an intelligent confrontation of this problem. An analysis of the relative worth of water in different uses could help form the basis for a reasonable and constructive approach to various issues which arise when an actual or potential short supply of this resource becomes restrictive to economic development. For example, it may be helpful in solving the problems encountered by regional development and planning organizations in their efforts to encourage types of economic activity which will allow a region to realize its full economic potential. Also, such an investigation may contribute to studies which seek to determine whether legal or political institutions tend to interfere with the free transferal of water to more highly productive uses. In addition, it may help to shed light on the issues arising out of subsidies to particular types of water users.

In the *Monthly Review* for April 1959, an effort was made to gather and analyze information which would shed light upon questions such as these relative to alternative water uses within the field of manufacturing. A method of analysis was described and applied which was based upon calculation of value added and employment per acre foot of water consumed in a variety of manufacturing industries. In this article, a similar methodology will be applied to other sectors of the District economy. While the technique used is simple in principle, it is difficult to explain briefly and, therefore, it will not be elaborated again in this article.[1]

The analysis of industrial water uses led to the conclusion that "while productivity- and employment-creating effects of water use in specific industries are closely related, both of these magnitudes vary greatly as between industries. This would seem to indicate that areas concerned with problems of actual or anticipated water shortage, and perhaps simultaneously the threat of excessive population, cannot well afford to be indifferent to the structure of industrial activity which they

[1] *The April 1959 article and the technical appendixes thereto may be obtained from the Research Department upon request. It should be noted particularly that the approach described in these documents is not the same as that used in benefit-cost studies and that it is not directed at the same sort of problem.*

develop." If impressive differences in the productivity of water consumed in various manufacturing activities are apparent, one might reasonably anticipate even larger disparity when less closely related types of economic activity are compared. In the present article, evidence is marshaled which permits a rough sort of water productivity analysis for the two major nonmanufacturing basic industries — mining and agriculture — in the District. Some comparisons of the results achieved in regard to these two sectors with those of the April article on manufacturing are then made.

However, before proceeding with these matters, it is desirable to point out that the reader cannot be warned too strongly that results of the following analysis and comparisons must be interpreted with great circumspection. There are several reasons for this. For one thing, the comparative analysis of the broad categories of water use undertaken here has relevance for regional development only when water is either actually or potentially stringent so that different water uses are or will, within some relevant time period, become true alternatives. This is the case because it is quite conceivable that any use of water, even one of very low productivity by our calculations, is, at least from the regional point of view, preferable to nonuse of that resource. Secondly, this analysis regards only the economic aspects of the comparisons made. It is entirely possible that social, aesthetic, or other goals will be considered over-riding by many people. Also, the calculation of productivity- and employment-inducing effects of water use in mining and agriculture presents more serious conceptual and statistical problems than does a similar calculation for manufacturing. Thus, while the broad comparative analysis of alternative uses made in this article undoubtedly has validity, it would be a mistake to attach much significance to the specific numbers which are derived. These should be taken as nothing more than relatively rough estimates. And finally, while the technique and broad comparisons presented here have relevance for local situations, any study of possible competitive water uses in a specific locality should proceed on a much less aggregated basis than was possible or desirable for the purposes of this article. Also, full cognizance must be given to the complex of factors which determine the locational efficiency of economic activity in order to determine whether the comparisons undertaken relate to what are or can be made alternatives. Activities are not actual alternatives unless they can be carried on independently.

The Productivity of Water in District Mining

The aggregate amount of water used in mining is relatively small. However, this sector, like manufacturing and agriculture, involves a basic economic activity which constitutes a major source of income in various parts of the Tenth District and in which water is often used directly in the productive process. Is the development and persistence of mining activity in areas where water shortage threatens to inhibit economic growth likely to prove an efficient or inefficient use of that resource relative to various alternatives, such as might be found or developed in the manufacturing field, for example? In making such a comparison, it should be remembered that the figures relating to the productivity of water in manufacturing probably have somewhat more relevance for regional policy making than do the mining figures. The reason is that the location of mining activity is less amenable to individual or collective choice than is the location of manufacturing activity. However, the scale at which such activity is carried on is, of course, subject to variation.

Table 1 provides some basis for comparison (with possible alternatives) of the productivity- and employment-inducing effects of mining water use. It will be observed that the figures for value added and employment re-

late specifically to the District rather than to national averages for these variables. In the April article, when manufacturing was under consideration, national averages were used. This was done because the relatively small development of that sector in the economy of a number of District states meant that much more detailed figures were readily available on a national basis. Also, it was felt that relationships between water consumption, employment, and value added — especially when production takes place in a supra-regional market — are heavily dependent upon technology and therefore figures derived from national averages would give a fair indication of relative magnitudes applicable to specific regions. In mining, this is obviously not the case since the conditions under which mining activities are undertaken differ much more radically from place to place due to differences in the accessibility and quality of deposits. This is true for a given mining activity from state to state even within the District. Thus, it is difficult to generalize about the mining figures, even when they are viewed on a regional level. However, a comparison of these figures with those relating to manufacturing does yield the conclusion that the productivities and associated employment-inducing effects of water consumed in the various mining activities lie well within the range attributable to manufacturing uses.

Table 1

Value Added and Employment Per Acre Foot of Water Depleted in Mining For Six Tenth District States, 1954

	Value Added	Employment
Bituminous coal	$74,367	10.8
Crude petroleum and natural gas	50,090*	1.8*
Nonmetallic and metallic minerals	9,963	.8

*Excludes Kansas.

NOTE: The basic water use and employment figures from which the statistics shown in this table were computed relate to the states of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, and Wyoming and are taken from the Census of Mineral Industries, 1954. The concepts of depletion relating both to mining water use and the municipal water use of the miners and their dependents are similar to those explained in the note to Table 1 in the April 1959 Monthly Review.

The maximum value added and employment per acre foot in manufacturing were, respectively, about $275,000 and 34, while the minima were a little over $6,500 and around 0.5, based on national average figures.[1] Thus, it appears that mining uses of water, in situations where this resource currently or potentially sets a limit to development, may very well be competitive with manufacturing uses in regard to their relative efficacy for achieving the regional goals of high production and numerous employment opportunities.[2] The exact relationship in a given area could of course be determined only by intensive study of the local situation.

The Productivity- and Employment-Inducing Effects of Agricultural Water Use

Recent Tendencies in District Agricultural Employment and Water Use

A basic industry of this region which has not thus far been considered in regard to the relationship between its water use and the production and employment it provides is

[1] *These figures were taken directly from Table 1 of the April* Review *article on manufacturing water use. In deriving both the manufacturing and the mining figures, water was allocated for municipal purposes to both the workers and their dependents. The technique whereby the municipal water allocation was converted to a depletion basis is explained in Table 1 of the April issue.*

[2] *In the April issue of the* Review, *it was observed that a mere consideration of the direct effects of industrial water consumption—even when the municipal requirements of the population induced by the water-using primary activity are taken into consideration—by no means exhaust the series of effects set up by such an activity. In that article, an employment multiplier approach toward including this chain in the analysis was used. This technique is explained in the technical appendix to that article. A similar technique was applied to the mining data. However, since the method used to include the full chain of effects due to mining was necessarily rather crude, and because the results did not alter the general conclusion stated above, the topic is not elaborated here.*

Table 2
Irrigated Acreages for Six District States

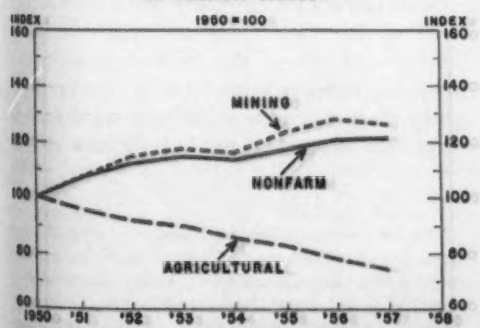
State	1944	1949	1954	1957 (Est.)	1958 (Est.)
Nebraska	631,762	876,259	1,171,369	2,408,000	2,593,000
Kansas	96,248	138,686	331,551	844,000	900,000
Oklahoma	2,237	34,071	108,151	295,000	297,000
Wyoming	1,353,873	1,431,767	1,262,632	1,400,000	1,500,000
Colorado	2,698,579	2,872,348	2,262,921	2,580,000	
New Mexico	534,640	655,287	649,615	750,000	775,000
Total	5,317,339	6,008,418	5,786,239	8,277,000	
Per cent of total cropland	6.48	7.00	6.97	9.99	

SOURCE: 1944, 1949, and 1954 figures were obtained from the U. S. Census of Agriculture; 1957 and 1958 estimates obtained from U. S. Department of Agriculture, Agricultural Research Service, in the various states.

agriculture. No resident of the District would require an elaborate analysis to show that agriculture is an important activity in the area. In addition to the income and employment generated directly in that sector, it is in fact the foundation for a large share of the manufacturing activity in District cities. Nevertheless, reference to the chart will indicate that –at least in terms of employment–it has experienced relatively diminished importance in recent years.

However, due to drastically labor saving developments in agriculture and due also to changes in the pattern of production, some nonlabor inputs have diminished relatively less than labor or even increased in importance in agricultural as compared with nonagricultural activities. An implication that this may well have been true of water in recent years is provided by a comparison of irrigated acreages over time. Unfortunately, the available data do not provide so clear-cut a conclusion as one might wish. Still, Table 2 does show a distinct increase in irrigated acreage since 1944,[4] and irrigated land as a percentage of total farm acreage also appears to exhibit a strong upward tendency. However, a perusal of the geographic distribution of increases in irrigated acreage reveals that supplemental irrigation on subhumid lands is gaining in importance relative to the watering of arid lands. This means that the average number of acre feet of water applied per irrigated acre has been falling. In any case, at the present time, perhaps 90 per cent of the water beneficially used in the District is diverted by agriculture. An even higher proportion of depletion is accounted for by that activity.

Changing Patterns of Employment in District States



SOURCE: Nonfarm and mining employment figures for the six District states from U. S. Department of Labor. Agricultural employment figures for four states (Colorado, Kansas, Nebraska, and Oklahoma) from U. S. Department of Agriculture.

A comparison of this predominant water-using activity with manufacturing and mining in terms of the value added and employment opportunities generated per acre foot of water

[4] *The number of acres irrigated fell between 1949 and 1954 but the spatial distribution of this decline suggests that it was due to short supplies of irrigation water caused by drought. This hypothesis gains support from the fact that those states for which 1957 or 1958 data are available show a rapid gain in irrigated acreage since 1954.*

used is important for those areas where water shortage is either actual or imminent.

Some Results of Water Use in Agriculture

Basically, two types of irrigation are carried on in the Tenth District. The one which is characteristic of New Mexico, for example, involves the watering of arid lands which would be incapable of sustaining an economically feasible agriculture without the artificial application of water. The other, which is characteristic of subhumid areas such as are typically found in the other District states, uses irrigation water as a supplement to natural rainfall. As indicated earlier, the relative importance of supplemental irrigation has been increasing rapidly.

Information which would allow the computation of water productivity figures for District irrigation, in accordance with the technique used for other sectors, unfortunately is not available in published form. Thus, it was necessary to contact individuals who might have such information at hand or who might at least be in a position to exercise judgment concerning the important variables. With this in mind, a number of agricultural economists were contacted in the various District states. Although most of the respondents were willing to contribute, in most cases they were able to furnish only rather limited information. The most detailed information was made available for Nebraska. Therefore, the statistics from Nebraska figure heavily in the following exposition of the method used to compute agricultural water productivity. However, it should not be inferred that the analysis in the article necessarily has any special reference to that state. The correctness of the order of magnitude and generality for other District states of the results achieved for Nebraska is roughly checked by the use of the less detailed and less firmly based information made available for several other states.

The additional value of product per acre due to irrigation in Nebraska was derived as shown in Table 3. In Table 4 the results of weighting the additional product per acre—after conversion to 1954 prices—with 1957 irrigated acreages of the various crops are indicated. It will be noted that 1,705,380 acres in 1957 produced an additional product of $79,983,883 in 1954 prices. It is estimated that the average application of irrigation water to crops in Nebraska varies from 1 to 3 acre feet a year, depending primarily upon the amount of natural rainfall which occurs in a given year. Since 1957 was a relatively moist year, one would presume that the application of water in that year would be near the minimum figure. If it is assumed that 1 acre foot was applied, the weighted average additional product attributable to each acre foot of irrigation water diverted would be about $47. It is estimated that about 60 per cent of the irrigation water diverted in Nebraska is depleted. Therefore, the additional product per acre foot depleted would be about $78.

The additional product concept used above is, of course, not directly comparable to the notion of value added which was considered appropriate for and was used in examining the regional effects of water use in regard to mining and industry. Value added, it will be recalled, refers to the differential between the value of product produced by an establishment and its purchases from other firms. Rough calculations indicate that between one half—on livestock farms—and two thirds—on cash crop farms—of the additional product of irrigated farms is value added.[5] Hence it appears that the value added per acre foot of irrigation water depleted in Nebraska agricul-

[5] *This calculation is based on budgets for a 160-acre farm found in* Systems of Farming in Irrigation Districts in the Republican River Valley *(Located in a Dry Subhumid Area), Bulletin 404, The Experiment Station, University of Nebraska, October 1951. Prepared by T. S. Thorfinnson, A. W. Epp, and W. H. Pine.*

Table 3
The Additional Gross Value of Crops Due to Irrigation in Nebraska

Per Acre in 1957 Prices

Crop	Irrigated	Not Irrigated	Additional Value Due to Irrigation
Corn	$ 83.38	$ 40.70	$ 42.68
Oats	30.93	20.19	10.74
Barley	33.84	24.00	9.84
Sorghum	56.25	32.13	24.12
Soybeans	68.31	51.28	17.03
Dry beans	123.84	44.64	79.20
Potatoes	276.64	114.66	161.98
Alfalfa hay	67.94	41.93	26.01

NOTE: The last column is treated as the value increment due to irrigation for each one of the indicated crops. Since the first two columns from which it is derived do not relate to the same plots of land, this differential may be influenced by differences in land fertility as well as by differences in moisture availability. A systematic bias would occur only if irrigated land were generally either better or worse than nonirrigated land. It seems probable that the bias, if any, would favor the irrigated land.

SOURCE: Information in the first two columns was supplied by the Agricultural Research Service, U. S. Department of Agriculture, Lincoln, Nebraska.

Table 4
Total Additional Value of Various Crops In Nebraska Due to Irrigation, Using 1954 Prices and 1957 Acreages

Crop	1957 Acreage	Additional Value of Crops (1954 Prices)
Corn	1,025,000	$ 55,060,879
Oats	34,000	412,188
Barley	20,000	232,543
Sorghum	247,000	7,513,246
Soybeans	17,570	415,352
Dry beans	58,010	5,260,150
Potatoes	14,310	2,609,192
Alfalfa hay	289,490	8,480,333
	1,705,380	$ 79,983,883

NOTE: Among the major irrigated crops in Nebraska in 1957 were 62,000 acres of sugar beets. Unfortunately, no estimate of the additional value produced by irrigation was available for this crop.

SOURCE: The figures for irrigated acreage in 1957 were obtained from the **Nebraska Agricultural Statistics Annual Report 1958, Preliminary Report 1957.** These figures were multiplied by the last column in Table 3 and the result adjusted to 1954 price levels in order to obtain the figures shown in the second column of this table.

ture was probably in the neighborhood of $50.[6]

As stated earlier, the information required to make a calculation for other District states similar to that made for Nebraska was much less detailed and to a greater degree based on estimates. In several cases no figures whatsoever were available. Nevertheless, the material at hand did permit crude productivity calculations which may serve as a useful check of the reasonableness of the general order of magnitude of the Nebraska figure. The value added per acre foot of irrigation water depleted for the states of Kansas, Colorado, and portions of New Mexico—which should represent a good cross section of District irrigated agriculture—all fell somewhat below the Nebraska figure. Various reasons could account for this result.[7] However, all the estimates fell within $20 of the Nebraska figure and therefore furnish some credence to the view that its general order of magnitude is reasonable. Thus, it is probably a justifiable estimate to say that the directly produced value added per acre foot of water depleted for the District states falls within the range of $30 to $50.

The only District state for which it was possible to make directly even an approximate calculation of employment attributable to irrigation was Kansas. For that state the result varied from 1/50 to 1/25 of a man-year per

[6] *It will be noted that no allocation of water for domestic purposes has been made in this analysis. The inclusion of such a figure would slightly reduce the indicated productivity of water in irrigated agriculture. The adjustment would be very small because domestic water use is a minute proportion of total water use on irrigated farms. As is implied by the following text, such adjustment could not be made since figures of population and labor force comparable to those of water use were unavailable.*

[7] *One or more of the following reasons could have played a part in this result: (a) The productivity of water may actually be higher in Nebraska; (b) Even though the analysis was carried out in terms of 1954 prices, the incremental product due to irrigation in various states was established for different years and the yield in relation to the amount of water applied varies somewhat from year to year; (c) The estimate that one acre foot of water per acre was diverted for irrigation purposes in Nebraska in 1957 may have been too low.*

acre foot depleted, depending upon the method of estimation.

The figures produced thus far relate, of course, to broad averages and it may be argued that a much higher productivity of water may occur in specific projects. In an attempt to discover how high value added per acre foot might rise under very favorable conditions, a productivity calculation was made for the San Joaquin Valley of California. This valley is among the most productive agricultural areas in the United States. The climate is favorable to plant growth, the soil is fertile, and the crops grown are for the most part of extremely high value. A technique basically similar to that used for analysis of the productivity of Nebraska irrigation was applied to the figures on value of crops produced and water diverted in this valley.[8] On the basis of this analysis, it appears that the direct value added in 1954 prices, per acre foot of water depleted, was about $150. It was not possible to compute employment per acre foot of water depleted for the San Joaquin Valley alone. However, for the entire Central Valley project—of which the San Joaquin is a substantial portion—the figure was about 1/25 man-year per acre foot.

The values added produced directly per acre foot of water consumed in mining and manufacturing appear to be many times as large as those produced in irrigated agriculture in the District or even in the San Joaquin Valley of California.[9]

Conclusions

The reader should remind himself that conclusions must be drawn from the foregoing analysis with great care. It appears strongly that the production- and employment-creating effects of agricultural water consumption are far smaller than those in the mining and manufacturing sector. Areas experiencing actual or potential water stringency may well wish to take explicit cognizance of this fact. The necessity for this is perhaps most impressive in those predominantly agricultural areas where production and employment opportunities will actually decline rather than merely suffer an inhibited growth in the absence of a reallocation of water use, highly water saving technological developments, or the development of new water sources. This would be the case in an area dependent on subterranean water supplies and in which the rate of pumpage exceeds the rate of recharge. In such an area the only means of avoiding future decline may involve a restructuring of production. For-

[8] *The basic figures on water diversion and crop production were obtained from* The Contribution of Irrigation and the Central Valley Project to the Economy of the Area and the Nation—*Report by Bureau of Reclamation, U. S. Department of Interior, for the use of Committee on Interior and Insular Affairs, House of Representatives, March 1956.*

[9] *No attempt is made in the text to take explicitly into consideration the induced effects of agricultural employment on nonagricultural sectors of the economy. This is because of the meagerness and low reliability of information concerning employment due to irrigation water use. However, hypothetical experiments using the technique outlined in the technical appendix to the April* Review *article on industrial water use, an agricultural employment multiplier (see H. C. Holje, R. E. Huffman, and C. F. Kraenzel,* Indirect Benefits of Irrigation Development, Methodology and Measurement, *Montana State College Agricultural Experiment Station, Technical Bulletin No. 517, March 1956), and reasonable values for the other variables indicate that induced or secondary value added is considerably larger relative to primary value added in agriculture than in industry. However, the relationship was not large enough to establish any presumption that the general comparisons made in the text would be altered if the entire analysis had been carried out in terms of direct plus secondary effects rather than in terms of direct effects only. The margin between agricultural and industrial value added would be narrowed somewhat if this could be done, but total value added per acre foot in the lowest manufacturing use would still remain a multiple of agricultural value added as calculated for the areas considered in this article.*

tunately, extreme cases of this nature are rare in the District. On the other hand, cases in which economic development may be inhibited by water shortage are foreseeable.

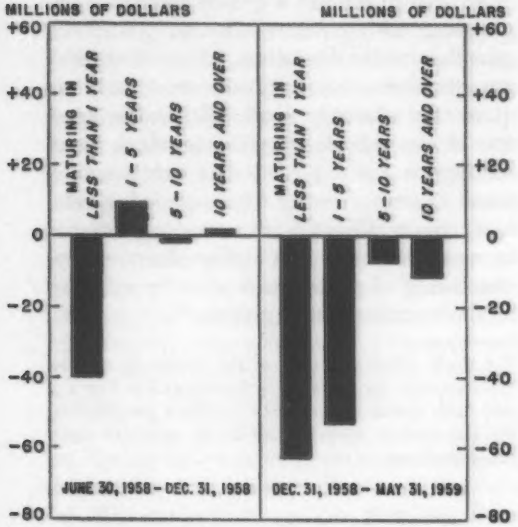
Still it is necessary to recognize and keep firmly in mind that agriculture can often be carried on successfully in areas where other economic activities not related to agriculture could not be and that in these areas a lack of agricultural development means no development of resources at all. In such cases the growth of new manufacturing activity may be completely dependent upon an increased scale of agricultural production. Therefore, manufacturing and agriculture are not true alternatives. Also it must be realized that a relatively small shift of water use from agriculture to most manufacturing or mining uses is sufficient to allow the water resources of an area to support a greatly increased employment and product. Hence, continued growth in water short areas, where alternative nonagricultural uses of water exist, may require only relatively small shifts in the structure of use. Also in situations in which water shortage is not a present fact but is anticipated in some relevant future period, a relatively heavy allocation of remaining supplies to nonagricultural uses rather than any restructuring of present uses may be sufficient to allow uninterrupted growth.[10]

[10] *A study which was done at the University of New Mexico under the auspices of Resources For The Future deals extensively with the problems presented by the appropriate allocation of newly available water in an arid area.*

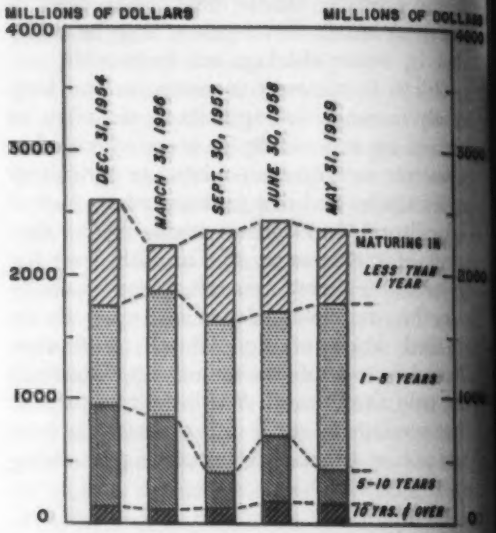
CHANGES IN TREASURY SECURITY PORTFOLIOS

Sample of Tenth District Commercial Banks

Estimated Net Market Transactions in Certificates, Notes, and Bonds



Ownership by Maturity Classes Selected Dates



BANKING IN THE TENTH DISTRICT

District and States	Loans		Deposits	
	Reserve City Member Banks	Country Member Banks	Reserve City Member Banks	Country Member Banks
	July 1959 Percentage Change From			
	June 1959	July 1958	June 1959	July 1958	June 1959	July 1958	June 1959	July 1958
Tenth F. R. Dist.	†	+14	+2	+13	−2	−2	+2	+6
Colorado	−1	+20	+2	+15	+4	+4	+2	+7
Kansas	+2	+10	+5	+11	+1	−2	+5	+8
Missouri*	+3	+11	+1	+19	−2	−5	†	+5
Nebraska	−1	+21	+2	+16	−3	−1	+3	+5
New Mexico*	**	**	+1	+17	**	**	+4	+13
Oklahoma*	−3	+10	−1	+10	−6	−5	−2	+5
Wyoming	**	**	+1	+13	**	**	+1	+5

*Tenth District portion only. **No reserve cities in this state.
†Less than 0.5 per cent.

PRICE INDEXES, UNITED STATES

Index		July 1959	June 1959	July 19[illegible]
Consumer Price Index	(1947-49=100)	124.9	124.5	123[illegible]
Wholesale Price Index	(1947-49=100)	119.5	119.7r	119[illegible]
Prices Rec'd by Farmers	(1910-14=100)	240	242	25[illegible]
Prices Paid by Farmers	(1910-14=100)	298	298	29[illegible]

r Revised.

TENTH DISTRICT BUSINESS INDICATORS

District and Principal Metropolitan Areas	Value of Check Payments		Value of Department Store Sales	
	Percentage change — 1959 from 1958			
	July	Year to date	July	Year to date
Tenth F. R. Dist.	+13	+12	+4	+[illegible]
Denver	+21	+14	−2	+[illegible]
Wichita	−2	+5	0	+[illegible]
Kansas City	+13	+13	+10	+[illegible]
Omaha	+10	+12	+6	+[illegible]
Oklahoma City	+15	+11	+5	+[illegible]
Tulsa	+10	+8	+3	+[illegible]